

Original article

# Trends in the prevalence of cerebral palsy in children born between 1988 and 2007 in Okinawa, Japan

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## Abstract

**Aim:** This study aimed to describe trends in CP prevalence among children born between 1988 and 2007 in Okinawa, Japan.

**Method:** This study was conducted during two time periods, Period I (from 1988 to 1997) and Period II (from 1998 to 2007), using data from the local CP registration system. We assessed cerebral palsy gestational age and birth weight specific trends in prevalence and analyzed these with Poisson regression analysis.

**Results:** Overall crude CP prevalence was 1.88 per 1000 live births. Approximately 70% of children with CP were born preterm or with low birth weight (LBW).

Overall CP prevalence increased in Period I and decreased significantly in Period II ( $P < 0.05$ ). Additionally, CP prevalence among children born with a birth weight between 1000 and 1999 g increased in Period I and decreased significantly in Period II ( $P < 0.05$ ). A significant decrease was found among the children born between 1995 and 2007 with a gestational age between 28 and 31 weeks ( $P < 0.01$ ).

**Conclusions:** There was a decrease in CP prevalence from 1998 to 2007, especially among LBW children and preterm infants. The high CP proportions among LBW and preterm infants are unique features of the population of Okinawa, Japan.

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**Keywords:** Cerebral palsy; Prevalence; Population-based studies; Gestational age specific prevalence; Birth weight specific prevalence

Cerebral palsy (CP) is among the most common childhood disabilities. Our previous study revealed that the 18-year survival rate of children with CP reached 89% in Okinawa [1]. Children with CP need adequate medical and social care during their lifetimes. Therefore, investigating the prevalence of CP among children is necessary for forming a basis for sufficient provision of

social and medical services for this population. Moreover, investigations of birth weight (BW) and gestational age (GA) specific prevalence are important for understanding the etiology of CP.

The overall prevalence of CP has been described previously in population-based studies from other countries [2–11]. These studies revealed that CP prevalence ranges from 2.0 to 3.0 cases per 1000 live births [2–10]. Trends in CP prevalence have been reported, [4–11] and they vary between countries. In Japan, however, such studies on CP prevalence have been limited [12–15]. This study reveals recent trends in CP prevalence in Japan and compares them with those of other countries.

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## 1. Methods

### 1.1. Surveillance methods

The surveillance methods used in this study were the same as those used in our previous study [1]. Thirty years ago, the Okinawa Child Development Center established a regional care system and the local registration system for children with CP in cooperation with other hospitals, health centers, and clinics in Okinawa Prefecture. Since then, we have continually surveilled CP in Okinawa. Most of the children with CP born in Okinawa Prefecture have been registered in the local CP registration database by researchers from the Okinawa Child Development Center until their third birthday. The researchers collected data for these children from their stored medical records at the Okinawa Child Development Center or other rehabilitation hospitals where they received treatment, except for those children with CP who did not receive rehabilitation therapy at any institutions in this local registration system because they underwent prolonged hospitalization at acute care hospitals due to severe complications or died before being referred to any of the above institutions. These data were reviewed and updated every 4–5 years.

For the present study, data were collected from the CP database. We did not include children with CP who moved to Okinawa after birth. We obtained ethical approval from the institutional review board of the Graduate School of Medicine at the University of Tokyo (No. 3913).

### 1.2. Definition of CP

The definition proposed during the International Consensus Meeting on CP in Bethesda, MD, USA [16], was used in this study. Children with CP-related brain injuries occurring 28 days after birth were excluded. Children who died before their second birthday were not included because CP can only be identified at or after 2 years of age.

### 1.3. Statistical analysis

Overall, BW and GA specific prevalence estimates were calculated using the number per 1000 live births. Because the graph of CP prevalence showed a peak and a linear spline, this study was divided into two periods, Period I (from 1988 to 1997) and Period II (from 1998 to 2007), in a post hoc manner. Since data for the GA specific population were not obtained before 1994, GA specific prevalence was only estimated between 1995 and 2007. Chi-squared and Poisson exact confidence interval tests were used to assess differences in the contingency tables for CP prevalence and properties. Multiple Poisson regression analysis with a

piecewise linear spline model with one knot for trend analysis was used to test for differences and trends in prevalence [17].

Multiple Poisson regression analyses require prevalence rates for all specified independent categories. Between 1988 and 2007, we acquired data for the numbers of CP births specified for each year and for all BW categories. Between 1995 and 2007, we acquired data concerning CP prevalence and birth rates for each year and the different GA categories. According to the trends we discovered, we assumed a linear spline consisting of two straight lines, one that ran from 1988 to 1997 and another that ran from 1998 to 2007. Its knot was at 1998.

Statistical analyses using contingency tables and the Poisson regression model were conducted with Stata 13.0 (STATA Corporation, College Station, TX, USA) and SAS 9.3 (SAS Institute, Cary, NC, USA). A two-sided *P* value of 0.05 was used to define statistical significance.

## 2. Results

### 2.1. Overall prevalence

A total of 639 children (368 males, 271 females) were identified as having CP during the two study periods. The mean age at entry into the CP registry was 25 months (SD: 2 months). The total number of children born in Okinawa Prefecture between 1988 and 2007 was 340,092 (174,947 males, 165,145 females). The overall crude prevalence of CP was 1.88 per 1000 live births. CP prevalence was significantly higher among males than females (Table 1, *P* < 0.01). The trend in overall prevalence in Period I increased, but not significantly, and Period II's prevalence trend decreased significantly (Fig. 1, Table 2, *P* = 0.02). As shown in Fig. 1, the neonatal mortality rate decreased, the low birth weight (LBW) rate increased gradually, and CP prevalence decreased in Okinawa in the 2000s.

### 2.2. GA and BW specific prevalence

Two cases had unknown GA, and 3 had unknown BW. Of all the CP cases, 102 children (16%) were born with BW < 1000 g, 174 children (27.2%) were born with BW 1000–1499 g, 117 children (18.3%) were born with BW 1500–1999 g, 68 children (10.6%) were born with BW 2000–2499 g, and 175 children (27.4%) were born with BW 2500 g or over (Table 1). Eighty-nine children (20.5%) were born at GA < 28 weeks, 144 children (33.2%) at GA 28–31 weeks, 80 children (18.4%) at GA 32–36 weeks, and 119 children (27.4%) at GA 37 weeks or over (Table 1). Approximately 70% of the children with CP were born with low birth weight (LBW, BW < 2500 g) or preterm (<37 weeks gestation).

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